FAUNAL SURVEY. I. THE DISTRIBUTION OF AQUATIC GASTROPODS OF THE NEW ENGLAND TABLELANDS

MAREE KOCH

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This survey of the distribution and abundance of aquatic gastropods of the New England Tablelands updates the information published by Simpson & Stanisic (1986) for the same region. All species showed marked reduction in both distributional ranges and abundances with no specimens of *Forsancylus enigma* found. Some seasonal loss of aquatic habitats within the Tablelands occurs annually, however the severity of the drought (January 2002 to present) has caused more extensive habitat loss and consequent loss of individual populations of aquatic snails. It is hypothesised that a combination of higher stock numbers and increased clearing of vegetation may be contributing to the reduction of aquatic snails as water levels are lowered and vertebrate faeces pollute habitats. ❐ *Aquatic gastropods, New England Tablelands, distribution, survey, pollution, habitat degradation.*

Maree Koch, School of Biological, Biomedical & Molecular Sciences, University of New England, Armidale 2351, Australia (e-mail: mkoch@pobox.une.edu.au); 1 March 2003.

This survey of aquatic gastropods of the New England Tablelands, New South Wales, was conducted between February 2000 and February 2003 and parallels a component of the Simpson & Stanisic (1986) survey of the same region (Fig.1). The region possesses a diversity of habitats that reflect the variations in both topography and climate experienced there. Temperate woodland partially cleared for agricultural use is abundant along the central highlands, merging with undisturbed temperate rainforests and wet sclerophyll forests along the eastern escarpment. The western slopes blend out into the alluvial plains west of Inverell and Barraba. Habitats are vulnerable and their existence is governed by climatic fluctuations within four distinct annual seasons correlated with the large altitudinal range of 1000-1500 metres across the region (Walker, 1977).

The aims of the survey were to establish the current distributional ranges of the aquatic gastropods in accordance with the initial survey of the New England Tablelands as described by Simpson & Stanisic (1986) and Heatwole & Simpson (1986); and to identify the trematode species infecting these aquatic molluscs (Koch, 2003a, 2003b). Terrestrial gastropods were not included in the current survey.

METHODS

The Australian Biogeographical Integrated Grid System (ABIGS) was used to map all species, in accordance with Brook (1977) and Simpson & Stanisic (1986). A grid of 5' longitude by 5' latitude was superimposed across the survey area, with each cell representing a 'quarter-cell' in the ABIGS system, each of these cells covering 76km^2. Shading of that cell indicates presence of a species in any part of a quarter-cell. Many quarter-cells were visited at least twice within the research period, with a final survey of the region completed between November 2002 and February 2003. Multiple visits to many sites at different seasons within the study period ensured that the possibility of seasonal occurrences of some species of gastropods was covered adequately.

Collections were made under logs and stones and amongst vegetation within dams, creeks and rivers, swamps, and backwaters using a dip net. Close examination of substrates and the stalks and leaves of aquatic vegetation was done by hand. Grid references from the original collection records (supplied by R. Simpson, 2000) were used to ensure that all sites visited during the original survey (Simpson & Stanisic, 1986) were again checked during this survey period. Collections were also made at locations other than those noted by Simpson & Stanisic (1986). Identification of all species was confirmed using the key to the terrestrial and freshwater gastropods of the New England region in Simpson & Stanisic (1986), and the non-marine mollusc key by Smith & Kershaw (1979). Any doubtful specimens were examined by Professor R. Simpson.

RESULTS

The basic features of shell formation and size of each gastropod species surveyed are illustrated in Fig. 2. Without exception, all species

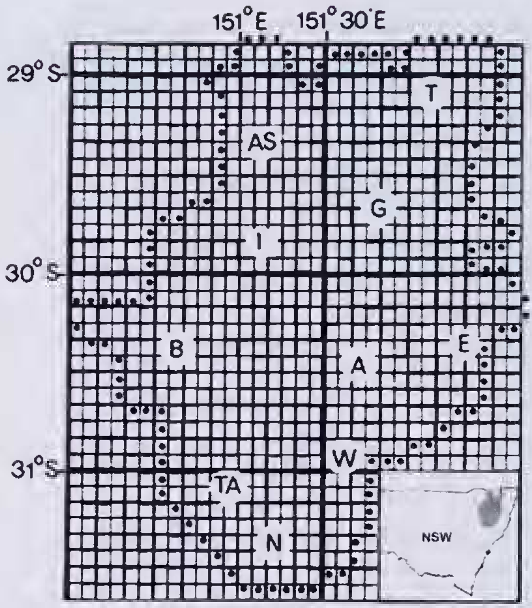

FIG. 1. ABIGS system grid superimposed over the New England region with the surveyed area enclosed by the solid dots. (AS, Ashford; A, Armidale; B, Barraba; E, Ebor; G, Glen Innes; I, Inverell; N, Nundle; TA, Tamworth; T, Tenterfield; W, Walcha) (After Simpson & Stanisic, 1986).

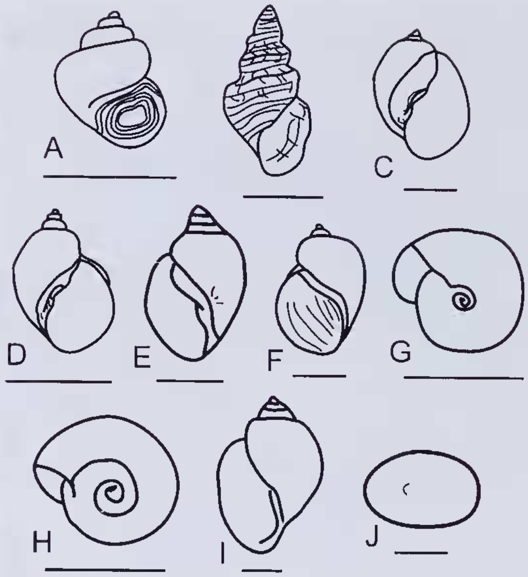

FIG. 2. Aquatic snail species of the survey area. A, *Gabbia vertiginosa*; B, *Plotiopsis balonnensis*; C, *Austropeplea lessoni*; D, *Austropeplea tomentose*; E, *Glyptophysa* sp.; F, *Isidorella* sp.; G, *Gyraulus metaurus*; H, *Pygmanisus pelorius*; I, *Physa* sp.; J, *Forsancylus enigma*. Scale bars: A-D = 5mm; E-F = 4mm; G-J = 2mm. (Source: M. Koch).

demonstrated reduced distribution, with no specimens of *Forsancylus enigma* being collected (Figs 3-12). At Dangars Lagoon 10km SE of Uralla, large numbers of dead *Physa* were collected on 2 occasions during 2000. No live snails were found at this location throughout the survey period.

Every species also demonstrated reduced abundance compared with the descriptions of populations by Simpson & Stanisic (1986). An exception to this was one population of *Gabbia vertiginosa* at Saumarez Road swamp (5km SSW of Armidale) where many hundreds were observed at every collection up to March 2002.

The Bureau of Meteorology Australia (BMA), on 8th October 2002, formally declared the entire New England Tablelands to be in the tenth month of the most profound drought to be experienced in recorded history. At the time of publication, the drought was still continuing across the region, with some rainfall between February and April 2003 providing surface water. As a direct consequence of loss of surface water and increased drawing on subterranean-fed bores and springs, swamp backwaters, roadside culverts and most drains and shallow water courses began to dry out from June 2002 onwards. Creeks and rivers that still contained water by February 2003 were reduced in both size and volume of flow. Figure 13 portrays the reduction of rainfall across the entire region in past years as compared to the mean annual rainfall calculated for the area between the years 1857 to 1997 by the Bureau of Meteorology Australia. For the 36 months January 2000 to December 2002, the survey region registered a departure from and below the Long Term Average (LTA) annual rainfall value of 500mm for the western and central sections and 1000mm for the eastern escarpments (BMA, 2003). The LTA is calculated based on the current international standard thirty year average annual rainfall for the area from 1961 to 1990 (BMA, 2003). The average annual evaporation rate for the Tablelands between January 2000 and December 2002, at 1232mm, was 15mm higher than the LTA (BMA, 2003). Weather patterns indicate a continuance of dry conditions to the spring of 2003.

DISCUSSION

Seasonal loss of aquatic habitats is a normal occurrence on the Tablelands as the heavy frosts and lower rainfall of winter coincide causing either reduction or complete removal of many shallow and vulnerable environments. Collections at sites during all seasons throughout the survey period ensured that such environmental factors had minimal impact on distributional patterns. The combined effects of lower rainfall and higher evaporation rates across the region leading into the current drought have caused further loss of habitats. Such harsh conditions can explain reduced species distribution from February 2000 to the present time. What factors could be responsible for such marked reductions in ranges between the first survey in 1986 and 2000? The aspect of human error must be considered to some extent as even the most experienced and diligent collector can miss a specimen. I believe this to have had a minor impact on the survey results.

The majority of wetlands are either surrounded by, or situated on, pastoral and agricultural leases, as are most of the creeks, dams and swamps within the survey region. The use of superphosphates on improved pastures and insecticides on crops in paddocks bordering aquatic habitats impact on the aquatic fauna by bringing about changes in water quality as these chemicals leach into the water systems (Ridge, 1995 in Ponder, 1997; Michaelis, 1984). High levels of land clearing and disturbance of country immediately surrounding aquatic habitats can also lead to siltation of microhabitats through topsoil erosion (Ponder, 1997).

Increased stock levels within the New England in response to the good seasons of the 1990's have impacted on the banks and substrates of dams and water courses which are largely unfenced (McKeon et al, 2000; pers. obs.). Higher stock numbers cause an increased draw on water supplies and significant organic matter being introduced via vertebrate

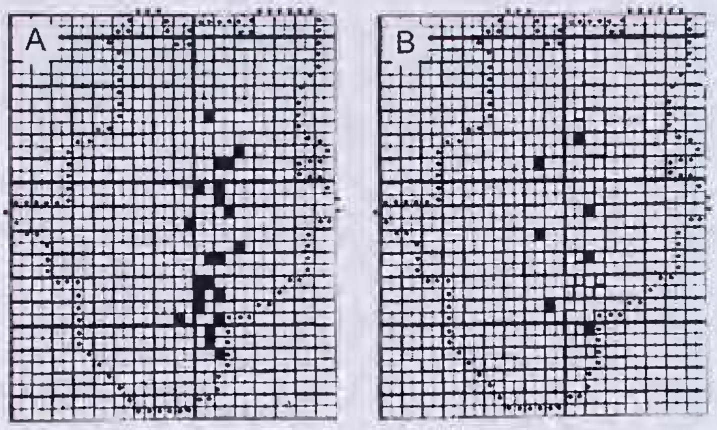

FIG. 3. Distribution of *Gabbia vertiginosa*. A, 1986 survey; B, current distribution.

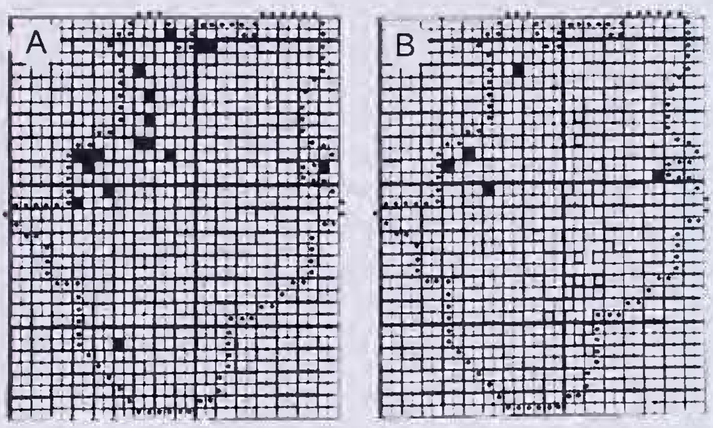

FIG. 4. Distribution of *Plotiopsis balonnensis*. A, 1986 survey; B, current distribution.

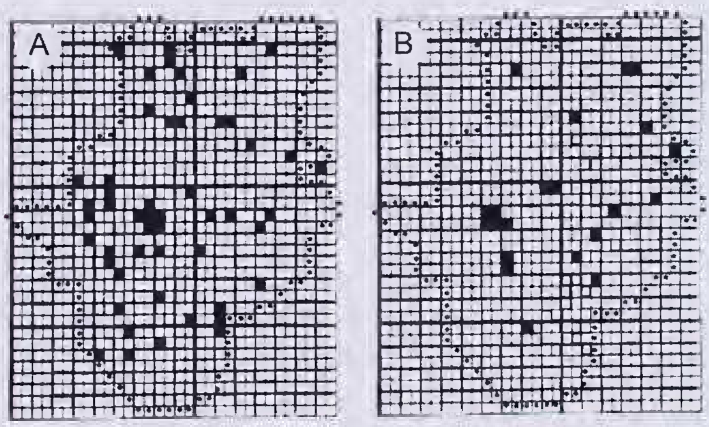

FIG. 5. Distribution of *Austropeplea lessoni*. A, 1986 survey; B, current distribution.

faeces, which in turn affects water quality by raising ammonium levels (Campbell & Doeg, 1989; Ponder, 1997). Once ammonium concentrations increase to 5mg/l or higher in standing or slow-flowing water, habitat conditions become toxic to invertebrate life (Romanowski, 1994). The tendency of regional pastoralists to retain high stock numbers during drought or dry seasons leads to further degradation of habitats that are already struggling for survival (McKeon et al, 2000).

Establishing the data on which to base sound responses to the above hypotheses is beyond the scope of the present study and requires a statistically designed survey over time to determine if there is a real decrease in species populations and distributional ranges. Comparing the results of the two surveys leaves no validity for conclusions on population increase or decrease to be correctly drawn. It is a situation deserving considerable concern, however. Due to their limited abilities to disperse, many of our aquatic snails have very narrow distribution ranges and some of the taxa present in New South Wales are endemic to this state (Ponder, 1997). If species distributional ranges and abundances have reduced to the extent indicated by the current survey in two decades, what effects will the current drought and agricultural practices have upon already vulnerable populations? Do we risk losing some aquatic gastropods from the New England Tablelands permanently? Have some, such as *F. enigma*, already been lost?

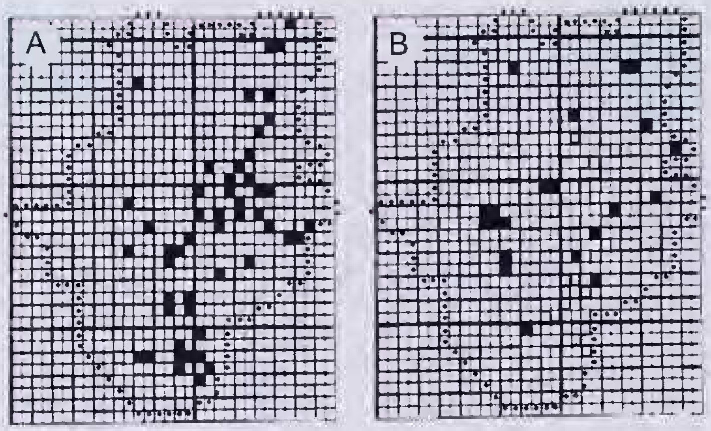

FIG. 6. Distribution of *Austropeplea tomentosa*. A, 1986 survey; B, current distribution.

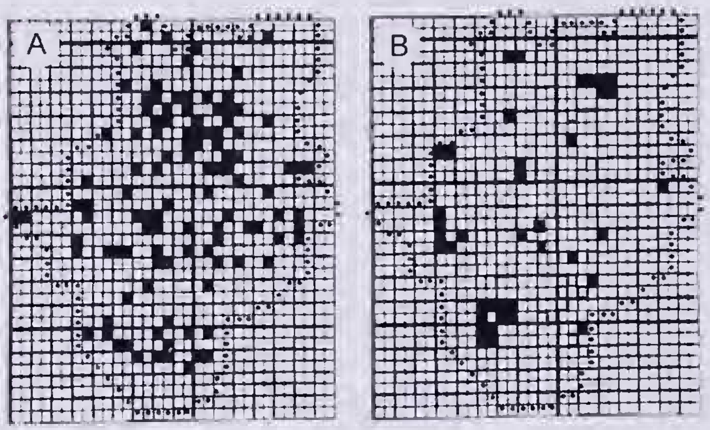

FIG. 7. Distribution of *Glyptophysa*. A, 1986 survey; B, current distribution.

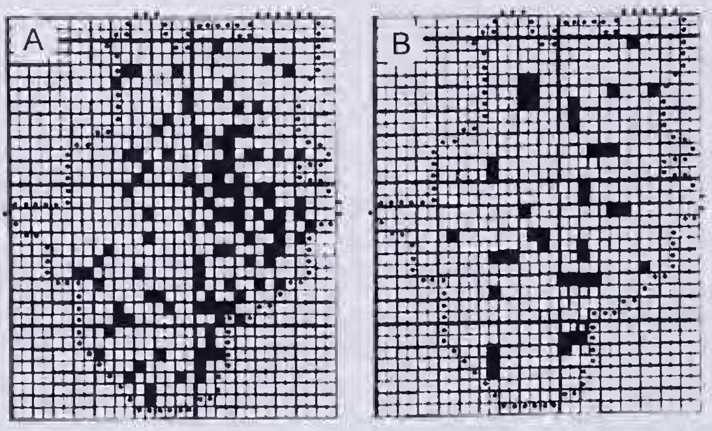

FIG. 8. Distribution of *Isidorella*. A, 1986 survey; B, current distribution.

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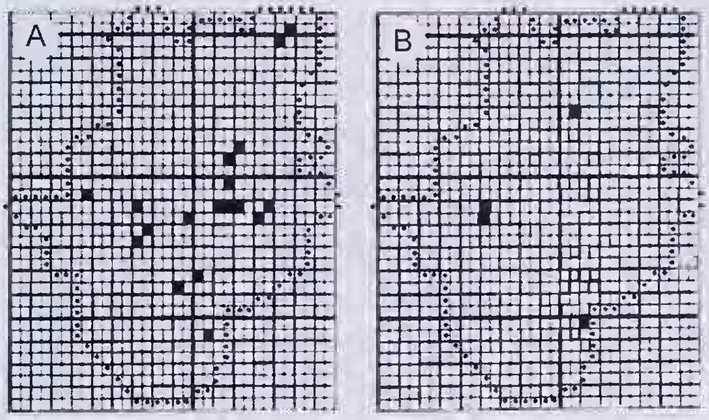

FIG. 9. Distribution of *Gyraulus metaurus*. A, 1986 survey; B, current distribution.

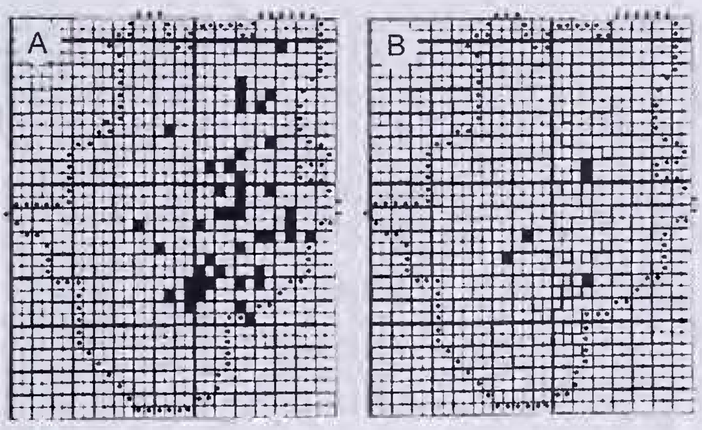

FIG. 10. Distribution of *Pygmanisus pelorius*. A, 1986 survey; B, current distribution.

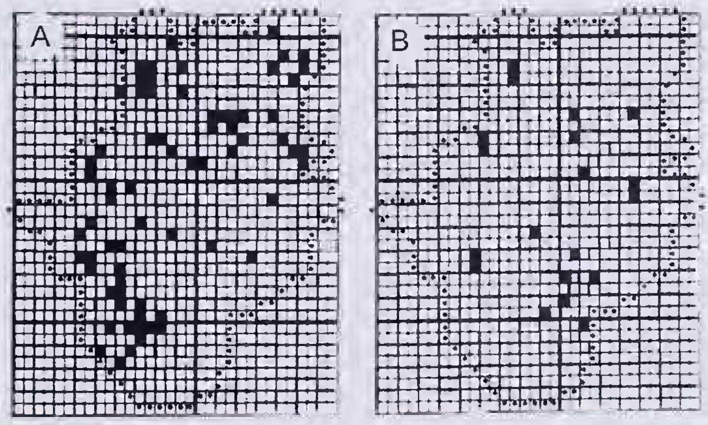

FIG. 11. Distribution of *Physa* sp. A, 1986 survey; B, current distribution.

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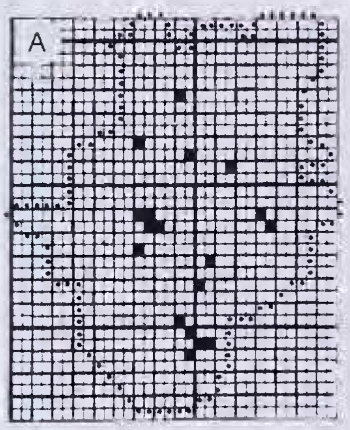

FIG. 12. Distribution of *Forsancylus enigma* sp. A, 1986 survey. This species was not found in the current survey.

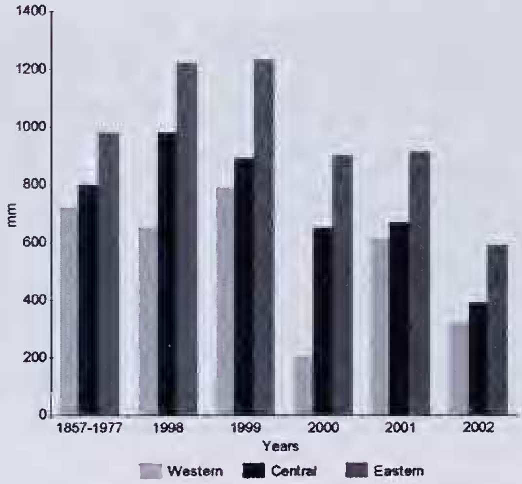

FIG.13. Annual rainfall in millimetres for the three geographical divisions within the survey region (years1998 to 2002), measured against the mean annual rainfall for the region recorded between 1857 and 1997 (134.5 years and 96% complete). Compiled by M. Koch from data recorded by the Bureau of Meteorology Australia.

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